2.15 COMMAND CHAIN HIERARCHY

Command and control is a concept primarily applied to military operations; however, the same concept is applicable to any situation involving relationships among entities. The command and control process enables a commander to understand the situation within his domain, select a course of action, issue intent and orders, monitor the execution of operations, and evaluate results.

The U.S. military defines command and control as the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in accomplishment of the mission.

A commander commands by deciding what must be done and moving subordinates toward a common goal; he controls by monitoring and influencing the actions which are required to accomplish the assigned mission.

Within most simulations, including SWEG, the user or author of the scenario fulfills the role of the highest level commander. The user defines the common goal and effects planning by creating players to represent the assigned and attached forces and to establish their initial status and positions within the scenario. In SWEG, these players can be organized into explicit and implicit command and control hierarchies, assigned missions through the definition of movement paths and tactics, and controlled through the generation of various platforms, elements, systems, capabilities, vulnerabilities, and tactics within each SWEG player. Communications networks and the types and contents of messages are also defined by the user to replicate the direction and coordination aspects of command and control.

Once the commander issues orders to be executed by a subordinate, the commander needs to monitor and influence the subordinate's actions in achieving the assigned missions. This aspect of command and control can only be accomplished with the existence of two-way communications. Commands and intent must be passed from commander to subordinate, and control would be impossible without feedback from subordinates. Feedback provides the commander with a way to monitor events, adapt to changing circumstances, adjust the allocation of resources, and integrate the efforts of the available personnel, equipment and facilities. The feedback may consist of information about the enemy, the surrounding environment, and the status and disposition of own forces.

The U.S. concept of command and control usually employs a hierarchy of commanders that can range from the Commander in Chief to the squad leaders in an infantry platoon. Within this hierarchy, intent and orders flow downward while situation reports, intelligence reports, and requests for guidance flow up the command chain. The command hierarchy carries out the concepts of authority and support. The relationships between members of the hierarchy specify the type and degree of authority one commander has over another and the type and degree of support that one commander must provide another.

At each level, U.S. commanders have autonomy within the confines of their operational plan and rules of engagement to select a course of action and implement it through intent

and orders to subordinates. A single command hierarchy may incorporate various degrees of autonomy at different echelons. In a large-scale operation, a commander responsible for deploying intercontinental nuclear weapons may have an extremely rigid operational plan while a Green Beret unit may employ a more democratic decision-making method for arriving at the course of action to achieve their assigned mission. Command and control can even be defined at the intra-platform level. For example, if the sensor receiver on a heat-seeking air-to-air missile loses its lock on the target, internal logic will tell the missile to abort; this could be viewed as an abort command to the missile from the logic processor. Command and control hierarchies for other nations' military operations may allow for either a greater or a lesser level of autonomy within each level of the command chain, and varying types of orders and information will flow throughout the command hierarchy.

SWEG allows the user to model all types of command chain hierarchies, and it provides the user with the ability to replicate each echelon's level of autonomy for implementing orders and decision making. The user is not required to use two sides; a SWEG scenario must contain at least one side, and the maximum number is 9,999. Command chain hierarchies within a side can be explicitly created as the user desires, except that each side must have at least one command chain and each player must be on at least one command chain. Nearly all command and control functions can be modeled in SWEG by user instructions for perceptions and tactics independently of the original definition of sides and command chains. For example, double agents or rogue platforms can be modeled within SWEG by placing them on more than one side, or merely by defining their tactics appropriately. The ability to assemble players within a side is primarily a means for the user to organize simulation entities into meaningful groups. SWEG provides the ability to represent command and control at various levels of detail which are implemented via the organization of the sides, command chains and players and the perceptions and tactics given to each player.

The user can design the instructions so that sides, command chains, and modes of control are listed as they would normally be used. But abnormal situations can also be represented if the user explicitly gives instructions to do so. As an example of this, consider the concept of skip echelon; i.e., a commander at one echelon communicating with a unit that is a subordinate of a subordinate. The normal use of the command chain hierarchies in SWEG may lead to the conclusion that SWEG cannot represent skip echelon communications. This is not true. The user can explicitly define perceptions for the commander and the subordinate's subordinate. Then the usual definitions of a common communication net and appropriate communication tactics for the two will allow this communication to occur as desired.

SWEG can model command chain hierarchies either explicitly or implicitly. Implicit representation allows the user to avoid defining communication links, etc. among the entities on the command chain. In an implicit representation, communication is perfect and instantaneous, all parties know everything about each other, and orders are always followed. Implicit modeling of command chains within a single SWEG player limits the ability of an explicit commander outside the implicit chain to monitor events, adapt to changing circumstances, and adjust resource allocations. This is because positions of individual platforms of a player are known only within the player; other friendly players perceive the entire player to be located at the position of its first platform. Thus, there is no means for a commander to monitor the activity of each platform of a subordinate player and adjust the mission's execution at that level. Explicit representation allows the user to

provide friendly players outside the immediate chain with more knowledge about the subordinates in the chain and more options for detailed orders to those subordinates. It also provides the user with many options for reactions to orders; subordinates may ignore, partially obey, totally obey, or totally disobey any orders in an explicit command chain.

2.15.1 Functional Element Design Requirements

a. SWEG will require the user to create at least one side within a scenario, and to assign each player to at least one side. The assignment of a player to a side will have only one implication: IFF. All players on the same side are IFF-friends. If a player belongs to multiple sides, it is an IFF-friend on the first side to which it is assigned. The IFF criterion can be used in tactics as the user sees fit, or not used at all.

b. SWEG will require the user to create at least one command chain for each side in a scenario, and to assign each player to at least one command chain. SWEG will allow a player to be in multiple places on one command chain. It will also allow a player to be on multiple command chains, possibly on different sides. The assignment of a player to a command chain will imply only that the player have friendly perceptions of its immediate commanders (if any) and immediate subordinates (if any) on the chain.

c. Except for the assignment to sides and command chains, SWEG will implement all command and control functions according to user instructions for perceptions and tactics. In particular, SWEG will provide the capability for the user to define friendly perceptions among players without regard to command chains or sides. Friendly perceptions are unrelated to IFF and will imply only that the perceived friend is available to receive orders or requests.

d. SWEG will provide the user with the capability to manage command, control and communications among scenario entities by permitting the user to define a player and its associated platforms, elements, and systems at varying levels of detail.

2.15.2 Functional Element Design Approach

In normal situations, a reasonable assumption for military simulations is that a well-organized set of sides and command chains are applicable. This is the assumption made in SWEG that allows users to organize the scenario by setting up sides and command chains. Perceptions of friendly players default to this normal situation. However, this user-friendliness does cause some confusion. In the real world people and organizations can belong to multiple sides simultaneously, and the determination of side is both context sensitive and sensitive to the viewpoints of the people involved and outside observers. Any attempt to consider the data associated with sides and command chains as real will result in limitations in the simulation. Orders are orders only when obeyed, for example. A commander is only a commander when the subordinates agree to permit the commander to be in charge. In SWEG, the initialization of perceptions, the definition of tactics and doctrine, and player behavior in general allows the user to ignore sides and command chains completely in the scenario, except for the instruction format assumptions that there must be at least one side, each side must have at least one command chain, and each player must be on at least one command chain.

Sides are used in SWEG only for IFF determination; i.e., players not on the same side are considered hostile solely for IFF, which may or may not be used. Explicit command chains in SWEG are maintained to organize some of a player's friendly perceptions (the default, normal perceptions of itself, commanders, and subordinates). Orders or requests need not come from a player on the same command chain or even on the same side, but they must come from a player with a friendly perception of the player receiving the request. However, even the term 'friendly perception' in SWEG refers only to a specific type of perception (at the player level of detail). There is no assumption in SWEG that the player represented by the perception will be, or should be, treated, or will act in return, in any manner that can be characterized as friendly.

While a SWEG player implicitly knows what side it belongs to, it does not implicitly know which other players are on its side or which players belong to other sides. The SWEG command chain modeling provides some implicit knowledge. For example, within a single command chain, a player will know its commander and its subordinates as well as their locations. However, the player will not have any implicit knowledge about its peers on a command chain or its commander's commander, although it can explicitly be given that knowledge by the user.

Command chains can also be defined implicitly within the structure of a single player. SWEG provides the user with maximum flexibility in replicating command chain hierarchies by giving him total control over the level of detail in the modeling of relationships among the simulation entities. This flexibility permits the user to hide details unimportant to him within an implicitly defined command and control entity and to create the methods for commands and reports to explicitly flow within a command chain whenever it is appropriate to simulate these details.

Portions of the command and control structure implicitly modeled as a single player with multiple platforms have perfect knowledge and perfect, instantaneous communication with each other. See Sections 2.1 - 2.2 for a detailed description of the player-structure in SWEG. Portions of the command and control structure explicitly modeled as separate players on command chains have knowledge of the identity of their immediate commander and immediate subordinates on each command chain and can use this knowledge and other user-defined friendly perceptions in their decision-making. They also perceive the location of each of these players to be the location of its first platform. All other command and control functions are controlled through explicit user instructions.

To illustrate the concept of command chain hierarchies and their SWEG implementation, consider command and control for naval operations within the Pacific area of responsibility (AOR). The Commander in Chief, U.S. Pacific Fleet (CINCPACFLT) is the head of the chain of command for all U.S. naval activity within the Pacific AOR. His two subordinate commanders are the Commanders in Chief (CINCs) for the Third and Seventh Fleets. Several task force commanders (Carrier Task Force (CTF)) are subordinate to each of the numbered fleet CINCs. These task forces might consist of homogenous platforms such as a squadron of ELINT-gathering aircraft or several attack submarines armed with land-attack cruise missiles. They may also be heterogeneous organizations consisting of an aircraft carrier and its embarked aircraft squadrons, escort and support ships, an attack submarine, and amphibious landing ships.

From a command and control perspective, each CTF reports up the chain of command to the numbered fleet CINC who then reports to CINCPACFLT. Each CTF is a peer in the chain of command under a numbered fleet CINC; however, each CTF is also the top of his own chain of command which includes the various ships, aircraft squadrons, or Marine Corps units and their respective commanders which comprise the CTF. For example, the subordinates to a CTF might include the commanding officers of the aircraft carrier and escort ships, the embarked airwing's commander, the commanders of the individual aircraft squadron's, and perhaps even the pilots of each aircraft.

Within SWEG, these command chain hierarchies can be implemented with various levels of explicit and implicit detail. A command chain can be created which has CINCPACFLT at the first level of the command chain, Commander Third Fleet (COMTHIRDFLT) and Commander Seventh Fleet (COMSEVENTHFLT) as peers at the second level of the command chain, and the various CTFs at the third level. The subordinates of the CTFs could be modeled explicitly; e.g., the fourth level would be the commanding officers of the afloat units, the airwing commander, and the brigade commander for the amphibious unit; the fifth level might contain the commanders of each aircraft squadron and the battalion commanders within the Marine Corps brigade, and the sixth level could contain the individual pilots of the aircraft and the company commanders within the Marine Corps battalion. Alternatively, the command chain hierarchy within each CTF could be modeled implicitly with the CTF represented as a single SWEG player with multiple components at multiple locations. (This implicit simulation of the task force's entities and their internal command and control within a single SWEG player might replicate COMSEVENTHFLT's view of each CTF as a single entity with multiple missions.) Command, control and communications will then be perfect within the CTF, so the user must decide whether or not this is appropriate for the specific scenario.

Command and control could also be modeled with even more detail. For example, rather than modeling a guided missile cruiser as a single entity with various sensors, communications equipment, and weapons systems onboard, it could be represented as several separate players: the long-range surface-to-air missiles, the early warning radar set, the beam rider sensor transmitter, the captain, etc. In this case, an explicit command and control hierarchy could include the ship's commanding officer, and the subordinate decision-maker(s) and components as individual subordinates on the command chain.

2.15.3 Functional Element Software Design

SWEG provides the structure of sides and command chains to the user in the SDB instructions only as a convenient method of organizing the scenario. As explained above, this structure does not prevent the user from designing player interactions in any way he sees fit. Thus, except for the code that parses these instructions or reproduces them for output, the only SWEG code pertinent to command chain hierarchy is that which addresses player perceptions and tactics. This code is part of the decision-making functional elements as described in Sections 2.9 - 2.11.

2.15.4 Assumptions and Limitations

No assumptions are made about the organization and relationships of forces.

2.15.5 Known Problems or Anomalies

None.